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Astrophysique N°

NOTES ET INFORMATIONS

Publication de l'Observatoire de Paris

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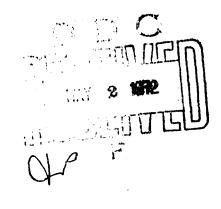
OBSERVATIONS DE LA NOVA RÉCURRENTE RS Oph.

B. FOLKART, J.-C. PECKER, S.R. POTTASCH, J. ROUNTREE-LESH

(Service d'Astrophysique générale, Observatoire de Meudon)

NATIONAL TECHNICAL INFORMATION SERVICE





Observatoire de Paris - 61, avenue de l'Observatoire - Paris - XIV

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AVERTISSEMENT

Avec le <u>Bulletin Astronomique</u>, que l'on trouve dans toutes les grandes bibliothèques, l'Observatoire de <u>Paris dispose</u> d'un moyen largement répandu d'expression et de diffusion, du reste ouvert à tous les auteurs sans distinction d'appartenance. Cette publication, dont la création remonte à quatre-vingts ans, a subi au cours du temps diverses transformations ; c'est aujourd'hui un recueil de Mémoires, c'est-è-uire d'ouvrages <u>longuement</u> médités, rédigés sous une forme définitive, et que le Comité de Rédaction prend la responsabilité de soumettre aux lecteurs,

Il a paru opportun de constituer parallèlement une seconde collection où seraient insérés des textes d'une autre nature, tels que des projets d'observations, d'instruments ou même de théories, sur lesquels on désire connaître l'avis de spécialistes avant de leur donner leur plein développement, ou encore des résultats d'observations, avec, éventuellement les conclusions provisoires de leur discussion.

Si ce titre n'avait déjà beaucoup servi, en aurait pu intituler cette nouvelle collection : Notes préliminaires. Les <u>Notes et Informations</u> constitueront une série unique, mais sur chaque fascicule figurera l'un des trois sous-titres suivants : ASTROMETRIE, ASTROPHYSIQUE, DIVERS, ce qui permettra aux lecceurs et aux bibliothécaires de subdiviser la collection s'ils le jugent bon. Sous la rubrique DIVERS, paraîtront notamment des rapports sur l'activité des divers services de l'Observatoire de Paris.

Des dispositions seront prises pour assurer la publication aussi rapide que possible des manuscrits qui parviendront à la Rédaction. Les fascicules ne paraîtront donc pas à date fixe, mais au gré des circonstances. Les auteurs appartenant à des établissements autres que l'Observatoire de Paris pourront soumettre au Comité de Rédaction les textes qu'ils désireraient voir insérer.

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A. DANJON
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RAPPORT PRÉLIMINAIRE SUR L'ÉTUDE DE L'EXPLOSION 1958 DE LA NOVA RÉCURRENTE R.S. OPHIUCHI

B. FOLKART, J.-C. PECKER, S.R. POTYASCH, J. ROUNTREE-LESH

(Service d'Astrophysique générale, Observatoire de Meudon)

Le spectre de la nova récurrente RS Ophiuchi a été observé aux observatoires des Mts. Wilson and Palomar, sur un domaine spectral éte du (3800-8500 Å) pendant 2 semaines, presque chaque nuit, comme indiqué sur le tableau I. Une étude préliminaire de ces spectres a été faite par Wallerstein (1959) et les plaques nous ont ensuite été confiées par le Directeur des Observatoires des Mts. Wilson and Palomar.

Notre projet comporte :

- 1/ l'établissement d'une liste des raies observées en fonction du temps;
- 2/ la mesure des longueurs d'onde de ces raies, à l'aide du spectre de comparaison de l'arc au fer;
- 3/ l'étude détaillée, en fonction du temps, de raies sélectionnées. Les plaques ont été calibrées grâce à des rpectres gradués obtenus à l'aide d'un diaphragme triangulaire;
- 4/ la détermination des intensités relatives des raies (décrément de Balmer, pour les composantes étroites et larges; raies interdites ...). Cette mesure repose sur une calibration photométrique de l'ensemble du spectre grâce à des mesures simultanées en 3 couleurs, effectuées par Connelley et Sandage, et aux mesures d'autres auteurs.

Nous avons actuellement accompli, pour la plupart des rules intenses, les points 1 et 2 de ce programme. Les résultats son: rassemblés dans la table II. Les longueurs d'onde pour les raies larges d'émission indiquent les pics d'émission, mais aucune utilisation ne doit en être faite, la seule grandeur précise devant venir d'une analyse dez profils. Il faut remarq er le dédoublement des raies fines d'absorption du calcium ionisé : l'une des comporantes est sans doute interstellaire et l'autre cir umstellaire.

Nous avons l'intention de compléter les points 1 et 2 par une recherche systématique de toutes les reles fines grâce à un examen détaillé des enregistrements comparés les uns avec les autres (ces raies fines ne sont pas détectables par un simple tracé moyen au travers d'un enregistrement isolé). Le point 3 de notre programme est en cours de réalisation; le point 4 sers examiné ensuite.

Dans notre interprétation ultérieure des résultats obtenus, nous avons l'intention de nous limiter à l'étude détaillée des couches extérieures, circumstellaires, de la nova. Dans ce but, nous nous proposons d'étudier spécialement :

- a) les raics interdites de l'oxygène, de l'azote, du néon;
- b) les raies de l'hydrogène;
- c) les raies de Call et de Hel;
- d) les raies interdites de Fell.

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PROGRESS REPORT ON THE STUDY OF THE 1958 OUTBURST OF THE RECURRENT NOVA RS OPHIUCHI

B. FOLKART, J.-C. PECKER, S.R. POTTASCH, J. ROUNTREE-LESH

On July 13, 1958, a new outburst of the recurrent nova RS Ophiuchi was discovered. This was the third outburst known, the previous ones occurring in 1898 and 1933.

The spectrum of the nova was observed at the Mount Wilson and Palomar Observatories in a wide spectral range, λ = 3800 to λ = 8500, beginning on the same night and continuing on almos each successive night thereafter for a period of two weeks⁽¹⁾. The decline of brightness of this nova is very rapid, but it is likely that the first spectra were obtained very close to maximum light, and probably not more than a day or two after the cutburst began. During the period discussed here the decrease in brightness was about 3 magnitudes.

An initial discussion of the wavelengths and possible origin of the sharp lines observed in these spectra was made by Wallerstein (1959). The plates have since been generously loaned to us by the Director of the Mt. Wilson and Palomar Observatories for further study. The plates under study are listed in Table I, which gives the date and time they were taken, the wavelength region covered and the spectral dispersion. The plates were all taken with a grating spectrograph so that the dispersion is constant along the length of the plate.

The spectrum is different from other novae in that it shows, along with the broad absorption and emission features, many narrow lines seen in both absorption and emission. These lines probably originate in an extended shell or cloud of material which surrounds the nova, as evidenced by the fact that eventually these sharp lines disappear (traces of these lines are still seen 3 weeks after the outburst was first noted). Thus the determination of the properties of this extended cloud (especially its mass and chemical composition) are an added interest in the interpretation of these spectra.

Our plan in reducing these spectra is to proceed in the following manner :

1/recompile a list of lines observed as a function of time in the spectrum;

- 2/ determine accurately the wavelengths of the lines, with the aid of the comparison spectrum.
- 3/ determine accurately the profiles of selected lines as a function of time, this being done with the aid of calibration plates which were taken for each plate on the same or similar emulsion and given the same developing;
- 4/ determine accurately the relative intensities of the lines, in particular the Baimer decrement for both the sharp and the broad components and the relative intensities of the forbidden lines. This will be accomplished with the aid of the 3 color photoelectric photometry done by Connelley and Sandage (1953), the 2 color photoelectric and photographic photometry done by Abrami and Cester (1960) and the determination of the relative continuum intensities by Bloch and Dufay (unpublished).

To date we have accomplished the first two of these points for all of the major lines. The results are shown in Table II. The wavelengths for the broad emission lines have no direct application, indicating only the peak intensity wavelength, and will assume more use when the profiles of the lines are discussed. Notice that there are two sharp Call H and K absorption lines

Simultaneously at the same observatory photoelectric magnitudes and colors (U. B. V system) were determined (Connelley and Sandage, 1958).

closely spaced. It would seem at present that one i. an interstellar line and the other originates in the cloud surrounding the star. This is deduced simply from the velocity measurements, one having a counterpart of the same velocity in the H and forbidden lines while the other velocity is reproduced only by the NaI lines. This can be confirmed by the relative change of the equivalent width of these two lines with time, which will be done.

We intend to complete point one by searching the tracings for all faint lines which might escape detection on a single tracing but will show up on a comparison of spectra taken on successive days.

Work on point three has proceeded to the extent that tracings have been taken and reduced of the intensity curve of each calibration plate at 100 Å intervals or each plate. The profiles of the lines will soon be determined.

Work on point four will begin upon the conclusion of the preceeding point.

After the conclusion of the observational part of the study we will begin on the interpretation. In the first phase of this work we will limit ourselves entirely to the determination of the structure of the material surrounding the nova, i.e. the outer layers of the nova. We will attempt to determine, as a function of time and space, the electron density and temperature, and the relative abundance of elements. To do this we will consider in turn :

- a) the forbidden lines of oxygen, nitrogen, and neon, which we have observed. The theory for the formation of these lines is well known (Aller, 1955), but the geometrical interpretation may be difficult;
- b) the hydrogen lines. If the lines originate from an optically thin layer their interpretation will be relatively simple. The first step thus will be to determine for which lines and at what period of development of the nova this will be true. It is suspected that this will prove only to be true for the higher Balmer lines and then only at the last period observed.

During the last five years methods have been developed to some extent for treating the optically thick cas, in specifying in a realistic manner the source function. These methods must be perfected and applied to this particular case. We also have particular interest in discussing theoretically the Balmer decrement in the optically thick case.

- c) the Call lines and the Hel lines. This case is similar to hydrogen in that methods are being developed for a realistic treatment of the transfer problem. We will further consider these methods in application to our observations;
- d) the forbidden lines of Fe⁺. This is a problem which has not yet been attacked theoretically, but has application to many atmospheres (planetary and diffuse nebulae, stars with extended atmospheres).

The problem is to determine collision cross-sections and Einstein A values for one or several simple systems consisting of 4 levels. It is felt that our knowledge of the Fe⁺ atom is sufficient at present to make such a theoretical study productive.

Further theoretical work dealing with the cause of the outburst will not be planned before our determination of the structure has advanced much further.

This study is supported by the U.S. Office of Naval Research under the contract NR 046-777, N 0001-60.

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TABLE I
PLATES OF NOVA RS OPHIUCHI 1958

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14	11:30	63	2800-5000		11	
15	8:00	31	5200-6700	xf 3740 3741	14	
15	9:02	61	3700-5000		22	
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EXPLANATION OF SYMBOLS IN TABLE II

a: absorption;

 \underline{a} : absorption; \underline{e} : emission: \underline{eb} : broad emission Entries in parentheses refer to the plate number in parentheses at the head of the column

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